

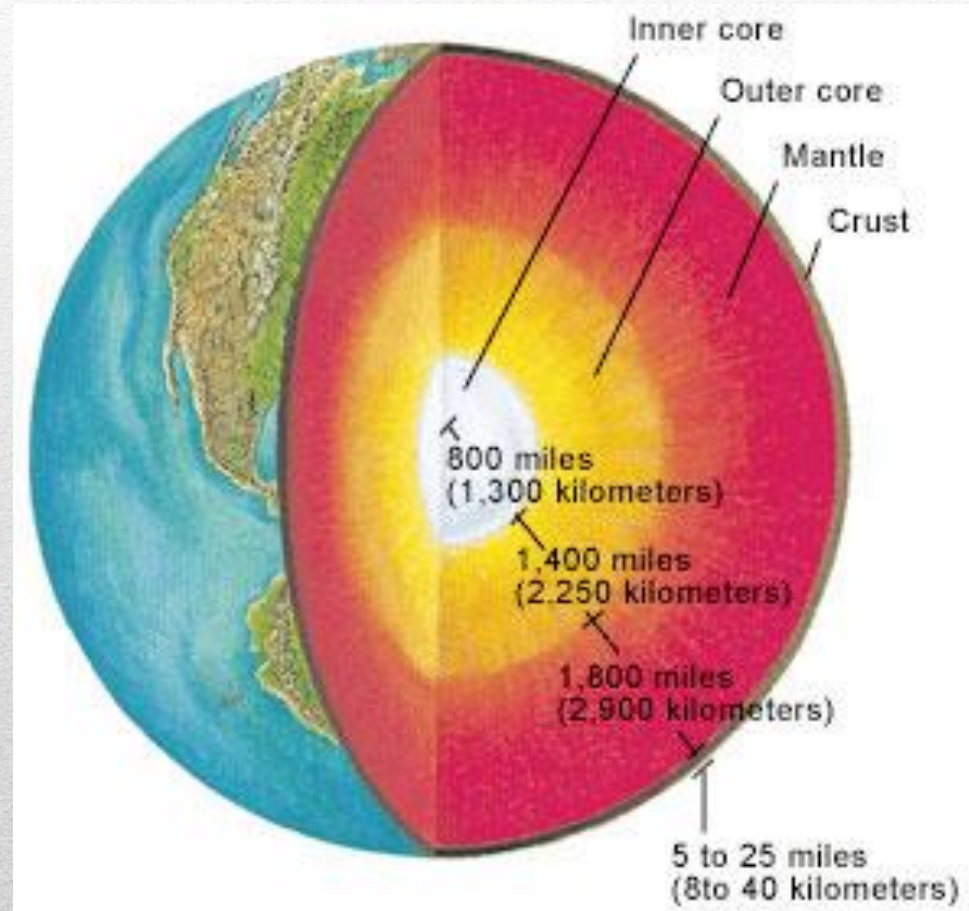
# **Introduction to Landform Study**

## **Chapter 13**

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# The Structure of the Earth

- **Four Regions**
  - The Crust
  - The Mantle
  - The Outer Core
  - The Inner Core

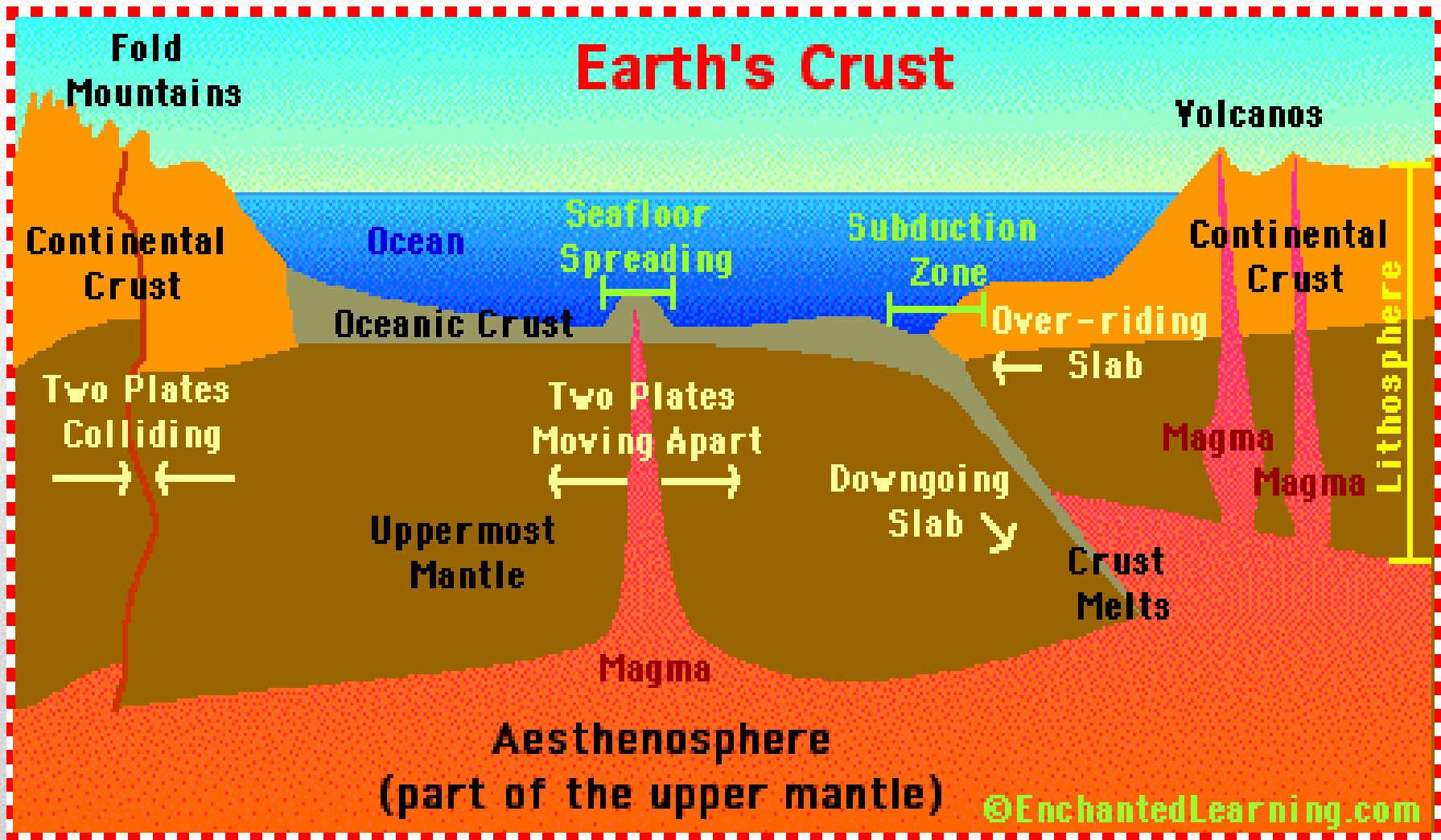




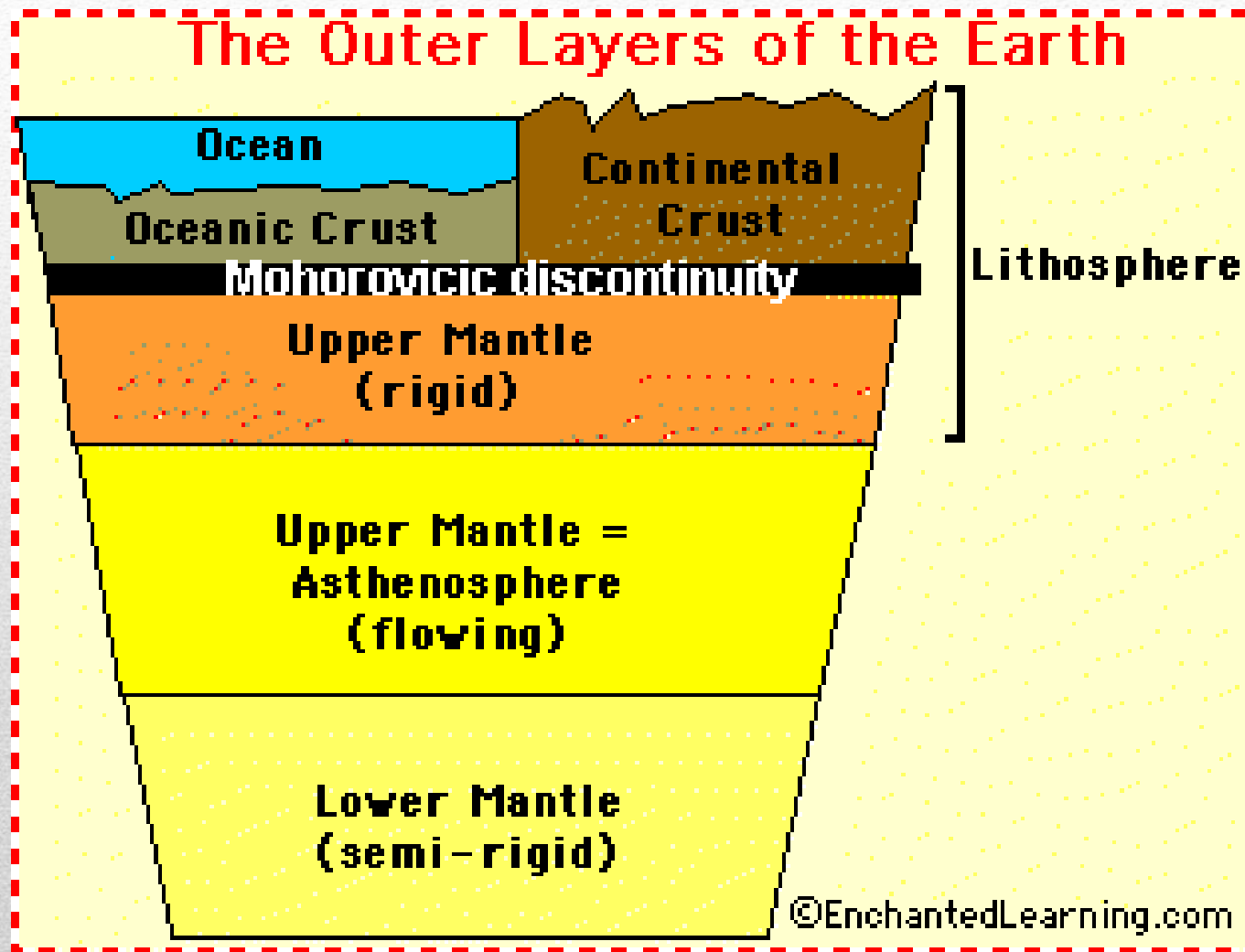
# The Crust

- The outermost shell, consists of a broad mixture of rock types
  - Average thickness averages 3 miles,
    - Beneath continents the thickness averages more than 5 times that much
  - The base of the Crust is a change in mineral composition, called
    - Mohorovicic discontinuity (or Moho)
-

# Earth's Crust



# The Mantle





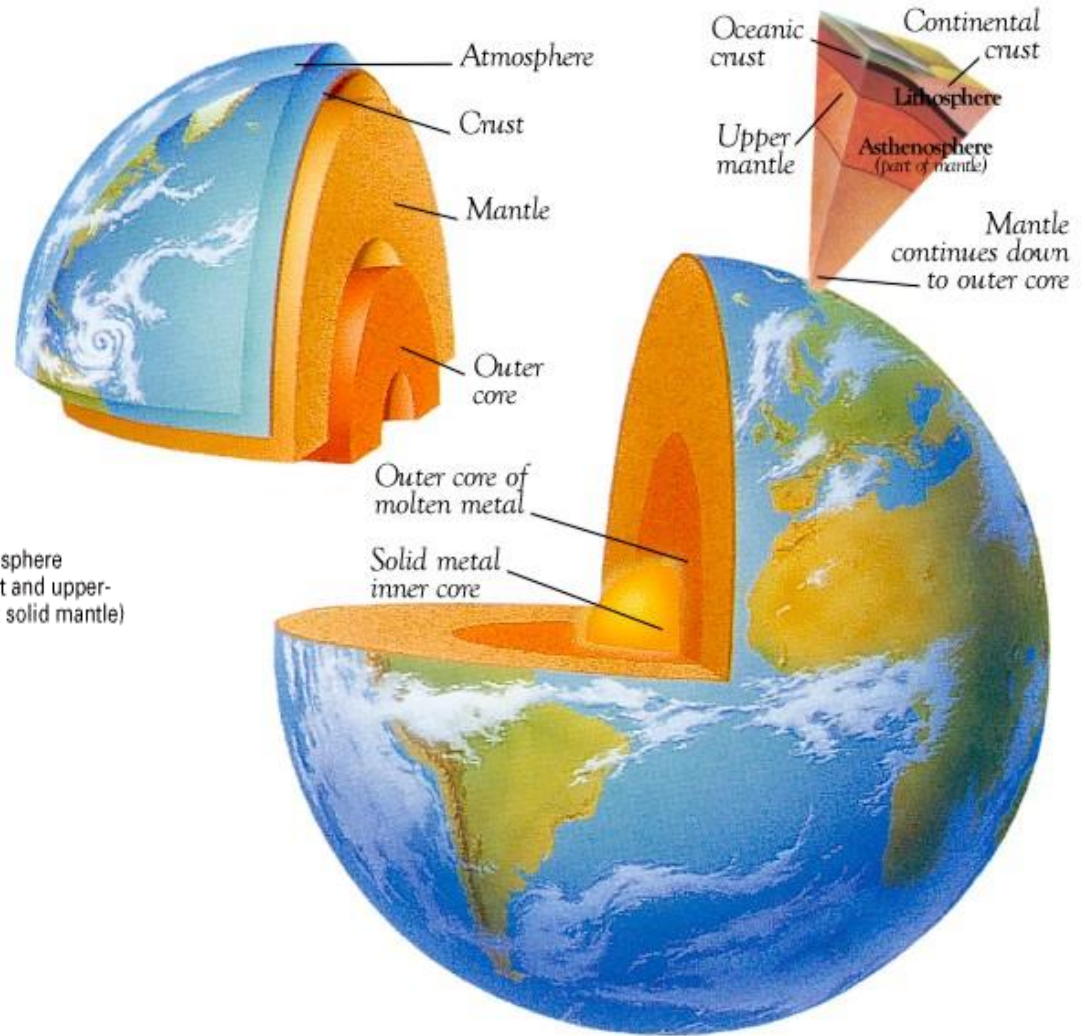
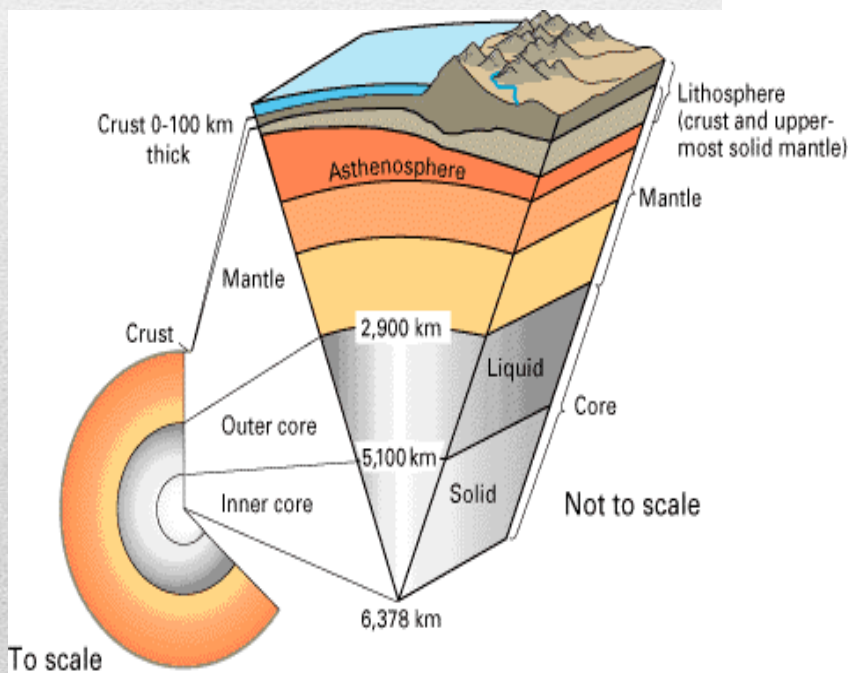
# The Inner and Outer Core

- The Outer Core

Molten and extending to a depth of about 3100 miles

- The Inner Core

- Solid and very dense mass having a radius of 900 miles
  - Both the inner and outer core are made of **iron/nickel** or **iron/silicate**.
  - Makes up **15%** of the Earth's volume and **32%** of its mass
  - The Earth's magnetic field is generated primarily in the **outer core**
  - Magnetic field changes over time from North Pole to South Pole
-





# Composition of the Earth

- Minerals
    - Solid
    - Naturally found in nature
    - Inorganic
    - Have a specific chemical composition
    - Contains atoms arranged in a regular pattern to form solid crystals
-



# Kinds of Minerals

- **Silicates** – composed of silicate minerals, oxygen and silicon
    - Quartz and feldspars are two most common
  - **Oxides** – elements that can combine with oxygen.
    - Iron, particularly hematite, magnetite, and limonite all containing iron
  - **Sulfides** – composed of sulfur in some combination with one or more other elements
    - Pyrite, iron and sulfur, galena/ lead
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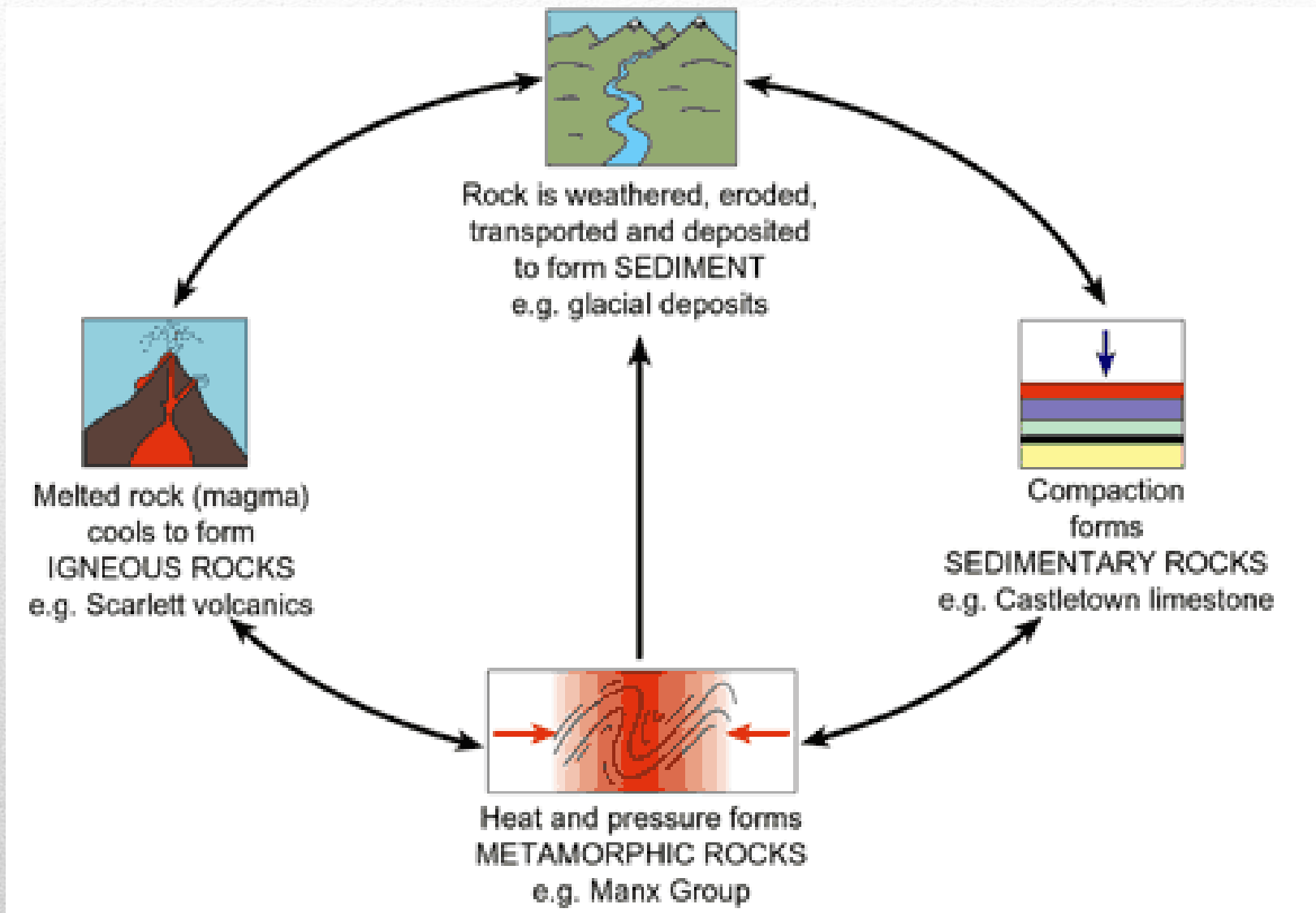
# Kinds of Minerals

- **Sulfates** – gypsum that contains sulfur and oxygen, calcium is the main principal combining element.
  - **Carbonates** – sedimentary rocks such as limestone (made up of calcium carbonate)
  - **Halides** – notably salty, halite or common table salt
  - **Native elements** – minerals that occur as discrete elements, gold or silver
-



# Rocks

- **Composed of mineral materials** – sometimes one mineral, other times many minerals
  - Sometimes found at the surface as an **“outcrop”** or below the surface as **“bedrock”** covered with a layer of broken rock called **“regolith”**
  - Three main kinds of **rocks**
    - **Igneous**
    - **Sedimentary**
    - **Metamorphic**
-

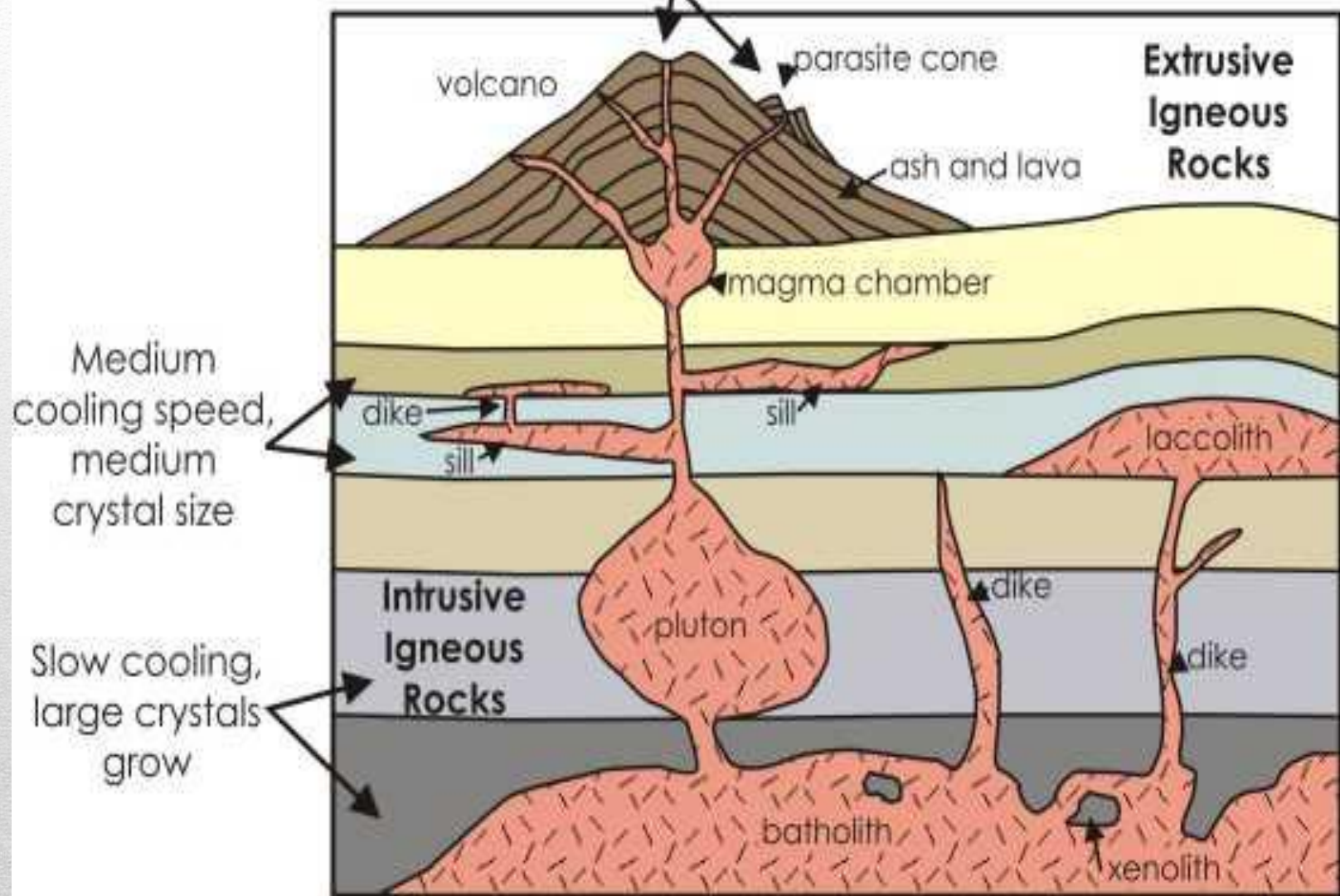




# **Igneous Rocks**

- **Formed by the cooling and solidification of molten rock (lava or magma)**
  - **Classification based on mineral composition and texture**
    - **Plutonic (Intrusive): Granite, Diorite, Gabbro, Peridotite**
    - **Volcanic (Extrusive): Rhyolite, Andesite, Basalt, Obsidian, Pumice, Tuff**
-

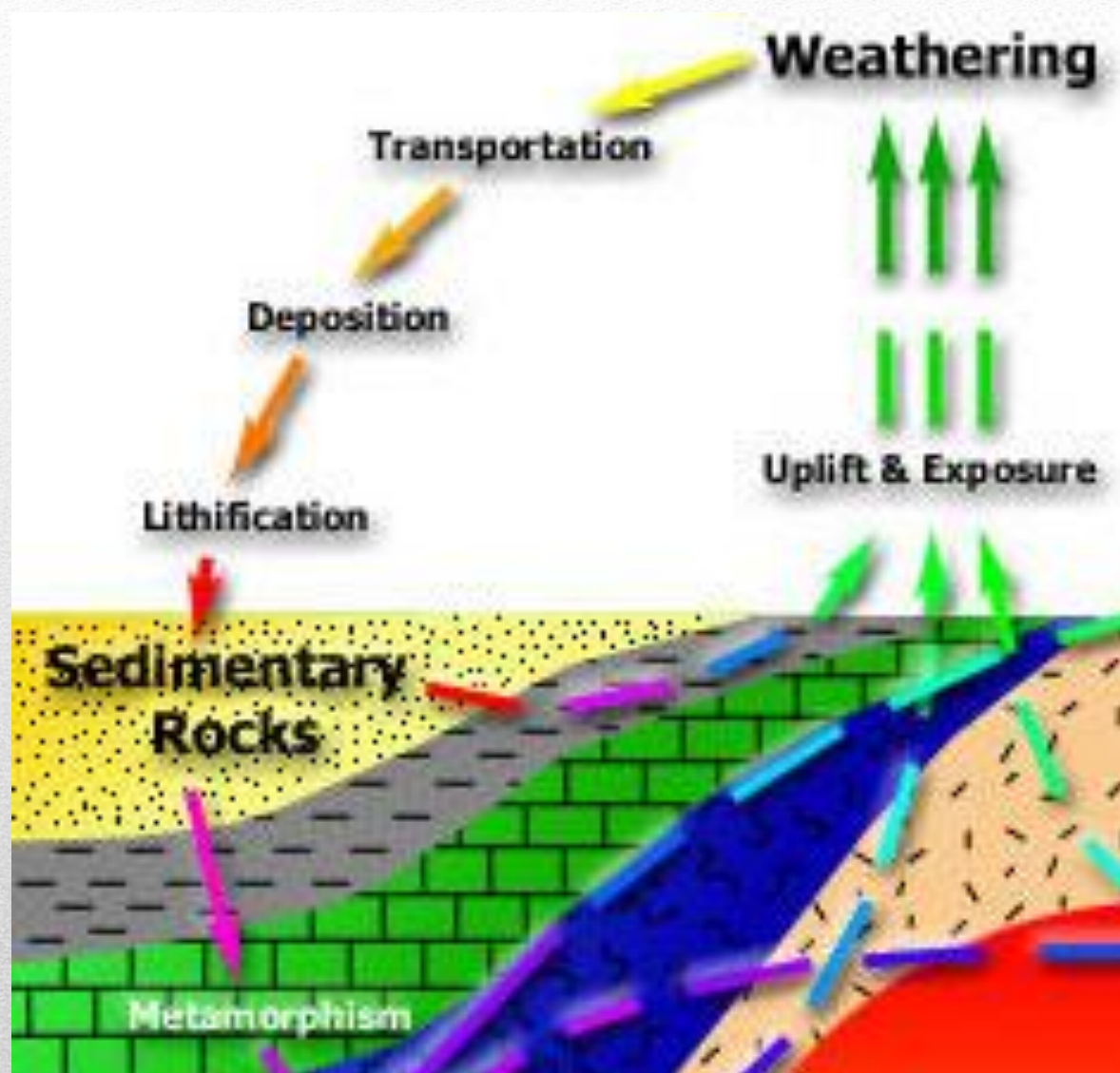
Fast cooling, fine crystal size





# **Sedimentary Rocks**

- **Created by the combination of pressure and cementation consolidates and transforms sediments**
    - **Clastic (Detrital): Shale, Sandstone, Conglomerate, Breccia**
    - **Chemical and Organic: Limestone, Travertine, Chert**
-





# Metamorphic Rocks

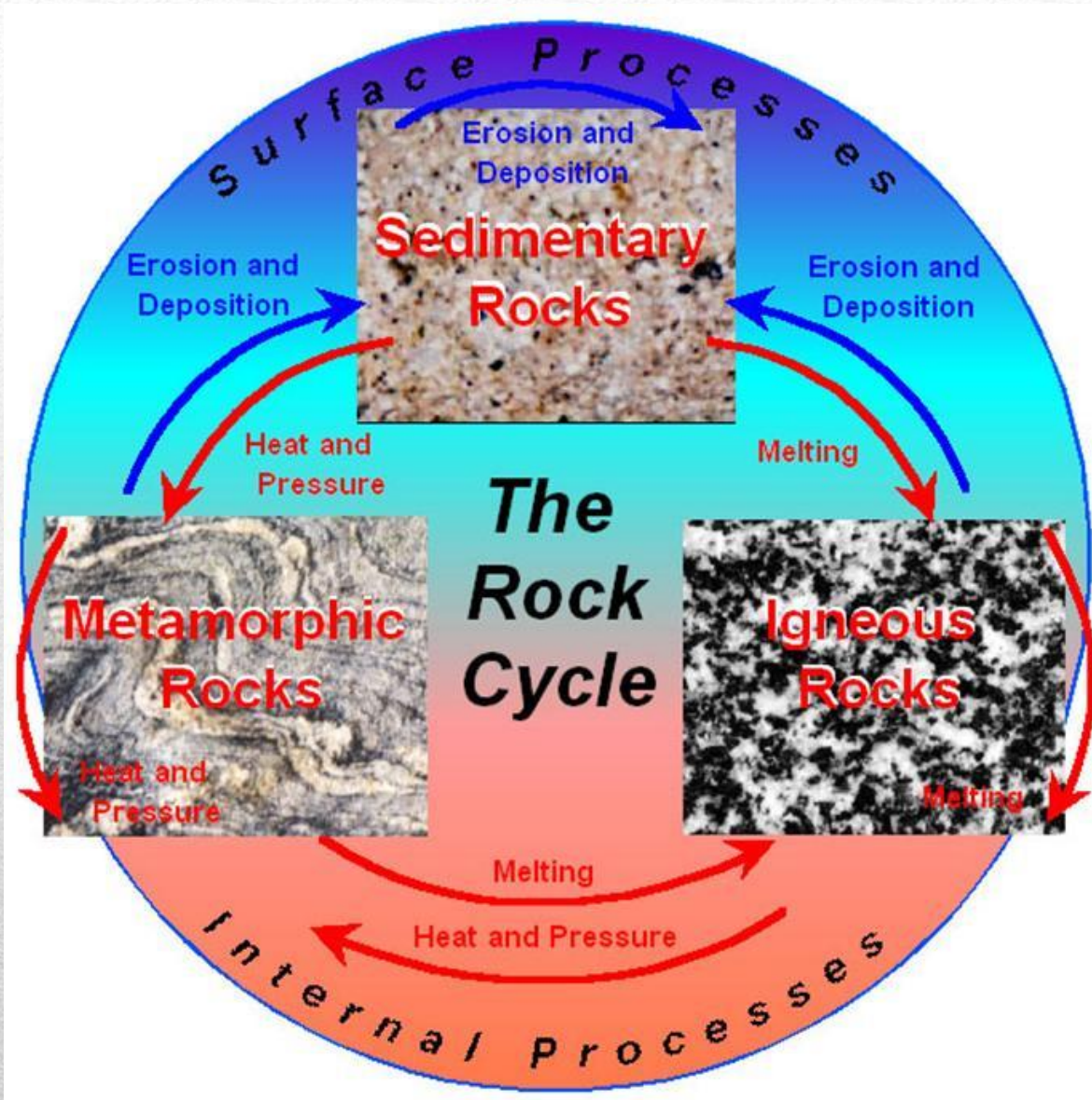
- **Drastically changed by heat and/or pressure** – Contact metamorphism and Regional metamorphism
    - **Foliated**: Slate, Schist, Gneiss
    - **Non-foliated**: Quartzite, Marble, Serpentine
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Metamorphic Rocks



Metamorphic Rocks





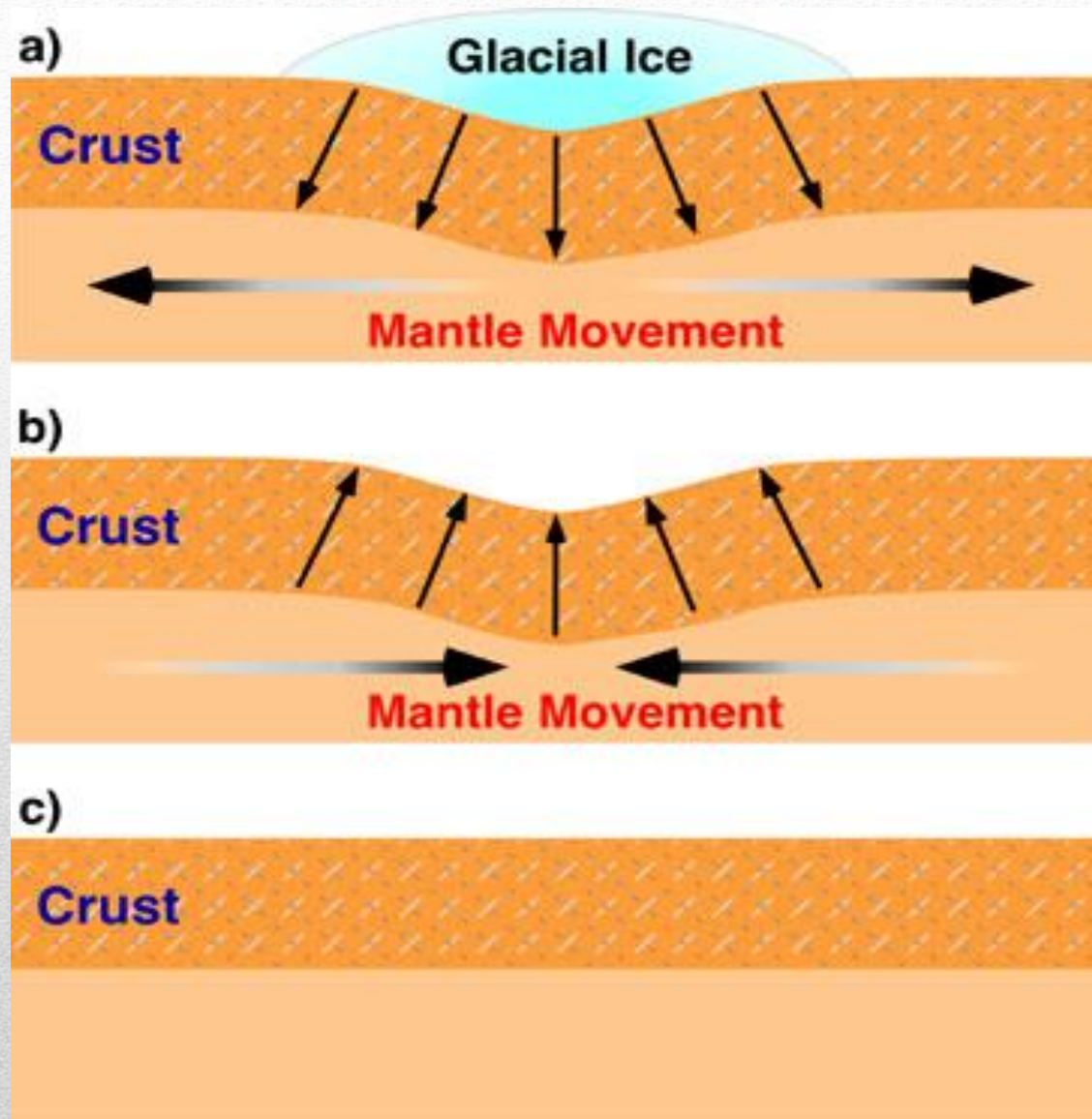
# Continental and Ocean Floor Rocks

- Continental crust consists mostly of granite
    - Less dense
  - Ocean crust consists mostly of basalt
    - More dense
  - Ocean crust is subducted under the continental crust
-



# Isostasy

- The crust is floating on the denser, deformable mantle below
  - Questions:
    - How deep is the sinking of the crust?
    - What determines the areal extent of an isostatic adjustment?
    - What is the immediacy of the isostatic response?
-





# The Study of Landforms

- Study of topography– geomorphology
    - Structure –the nature, arrangement, and orientation of materials making up the feature being studied.
    - Process– the actions that have combined to produce the landform
    - Slope – the fundamental aspect of shape for any landform
    - Drainage – the movement of water (from rainfall to snowmelt), over Earth's surface or down into the soil and bedrock.
-

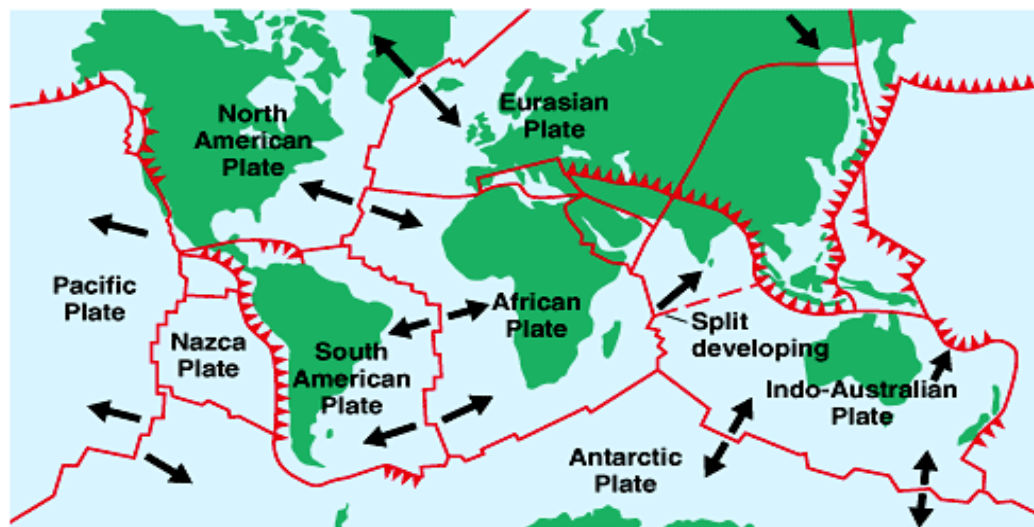
# To analyze topography answer these questions

- **What?** The form of the feature or features
  - **Where?** The distribution and pattern of the landform assemblage
  - **Why?** An explanation of origin and development
  - **So what?** The significance of the topography in relationship to other elements of the environment and to human life and activities
-

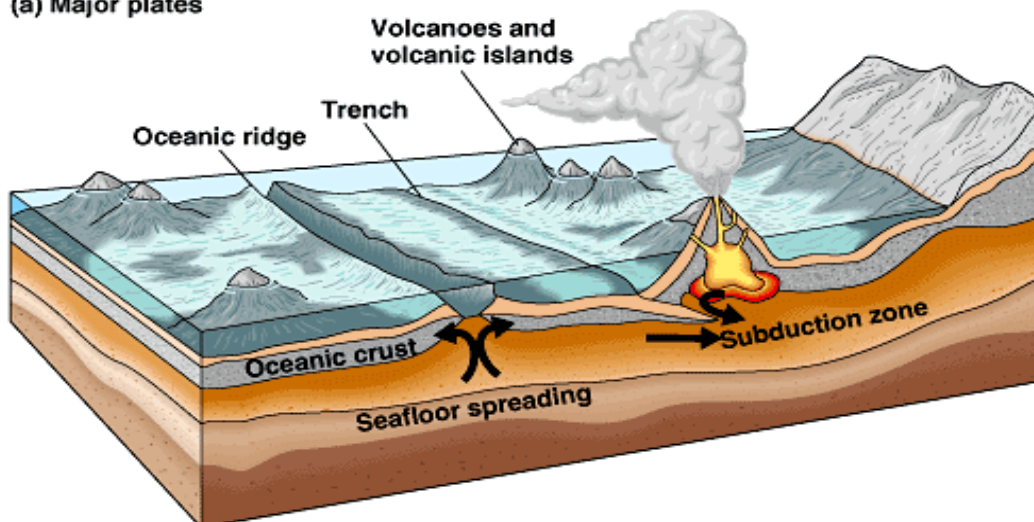


# Internal Geomorphic Processes

- Crustal rearrangement (plate tectonics)
    - Folding
    - Faulting
    - Uplifting
  - Vulcanism
    - Extrusive
    - Intrusive
-



(a) Major plates



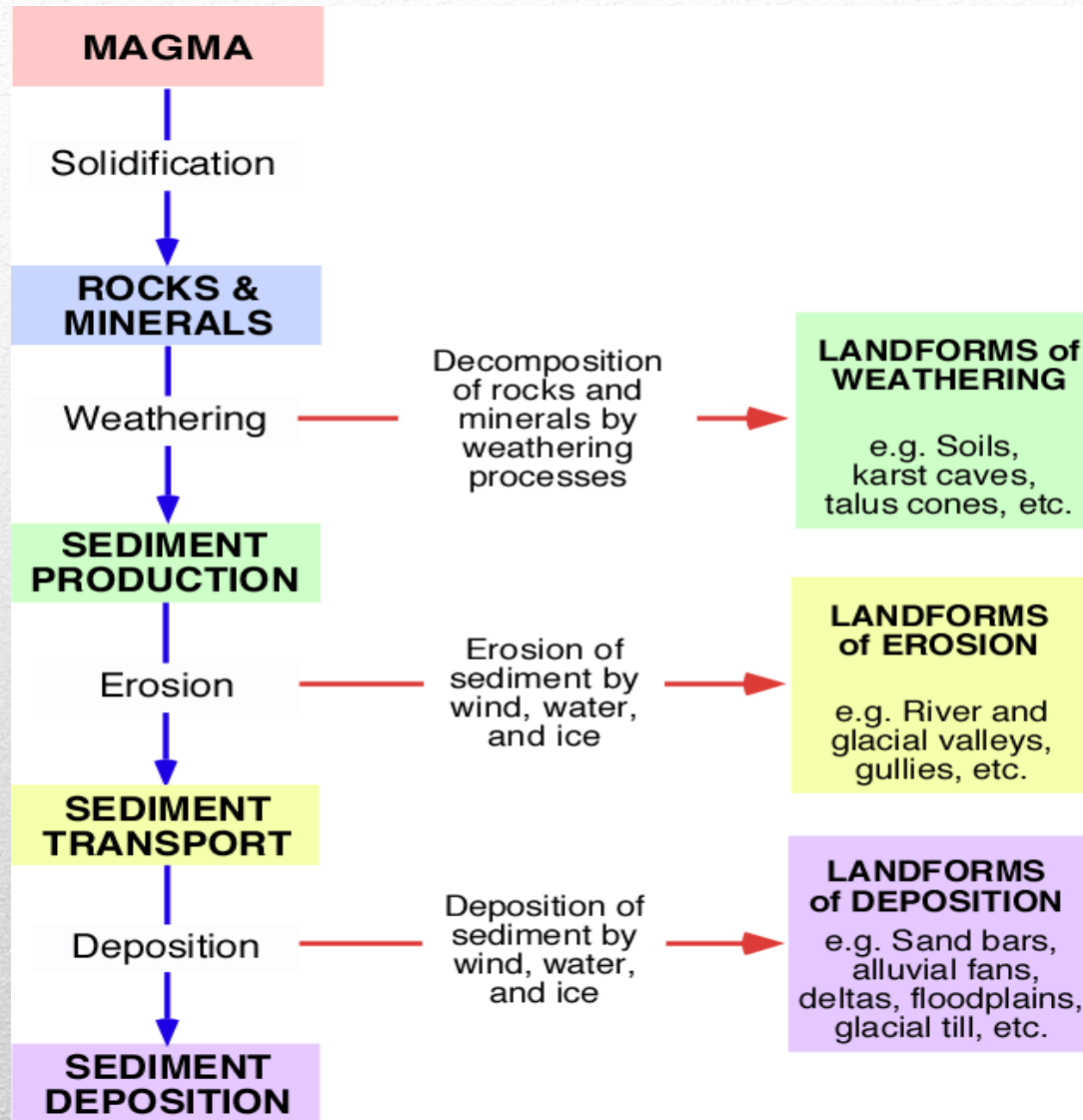
(b) Events at plate boundaries

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# External Geomorphic Processes

- Weathering
  - Mass Wasting
  - Erosion/deposition
    - Fluvial (running water)
    - Aeolian (wind)
    - Glacial (moving ice)
    - Solution (ground water)
    - Waves and currents (oceans/lakes)
  - Study of these processes Uniformitarianism
-





# Geologic Time

- Earth is about 4.6 billion years old
  - Age of the dinosaurs 160 million years ago
  - Rocky Mountains uplifted 65 million years ago
-

EON	ERA	PERIOD	EPOCH	Ma
Phanerozoic	Cenozoic	Quaternary	Holocene	0.01 —
			Pleistocene	0.8 —
		Tertiary	Late	1.8 —
			Pliocene	3.6 —
			Early	5.3 —
			Late	11.2 —
			Miocene	16.4 —
			Early	23.7 —
			Oligocene	28.5 —
			Late	33.7 —
			Early	41.3 —
		Paleogene	Eocene	49.0 —
			Early	54.8 —
			Late	61.0 —
			Paleocene	65.0 —
			Early	
	Mesozoic	Cretaceous	Late	99.0 —
			Early	144 —
		Jurassic	Late	159 —
			Middle	180 —
			Early	206 —
		Triassic	Late	227 —
			Middle	242 —
			Early	248 —
		Permian	Late	256 —
			Early	290 —
	Paleozoic	Pennsylvanian		323 —
		Mississippian		354 —
		Devonian	Late	370 —
			Middle	391 —
			Early	417 —
		Silurian	Late	423 —
			Early	443 —
		Ordovician	Late	458 —
			Middle	470 —
			Early	490 —
		Cambrian	D	500 —
			C	512 —
			B	520 —
			A	543 —
Precambrian	Proterozoic	Late		900 —
		Middle		1600 —
		Early		2500 —
	Archean	Late		3000 —
		Middle		3400 —
		Early		3800? —



# **Major Landforms Assemblages of the World**

- **Flat Plains**
  - **Irregular plains**
  - **Plains with scattered hills/mountains**
  - **Tablelands**
  - **Hills**
  - **Mountains**
  - **Ice caps**
-